



## Review

## A roadmap to inpatient heart failure management

Muthiah Vaduganathan (MD, MPH)<sup>a</sup>, Mihai Gheorghiade (MD)<sup>b,\*</sup><sup>a</sup> Department of Medicine, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA<sup>b</sup> Center for Cardiovascular Innovation, Northwestern University, Feinberg School of Medicine, Chicago, IL, USA

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## ABSTRACT

Heart failure (HF) accounts for over 1 million primary hospitalizations in the USA each year and carries a tremendous burden on costs and patient outcomes. The clinical syndrome of HF is not a single disease, but represents the complex interplay between various cardiac and non-cardiac processes, each of which need to be individually addressed. This review provides an updated, contemporary roadmap for inpatient worsening chronic HF management with a focus on identifying and addressing initiating mechanisms, amplifying factors, and cardiac structural abnormalities. Inpatient risk stratification should guide patient education, team structuring, disposition, and post-discharge monitoring.

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## Introduction

Heart failure (HF) is the primary diagnosis in over 1 million hospitalizations annually in the USA alone, and is listed as the secondary diagnosis in another 3 million [1]. The cumulative burden of hospitalizations for HF is staggering. Over half of the 30 billion US dollars utilized in HF-related care each year is spent in

the inpatient setting [1]. Hospitalization for HF also has a direct impact of patient-related health outcomes, including quality of life [2]. The widespread implications of HF hospitalizations and rehospitalizations have captured the attention of multiple stakeholders beyond the practicing clinician and patient. The Centers for Medicare and Medicaid (CMS) have adopted specific performance measures to set benchmarks for quality in hospitalized HF patient care [3]. The American College of Cardiology Foundation/American Heart Association (ACCF/AHA) national guidelines have now included in their most recent iteration, a section dedication to hospitalized HF patients [4]. Recent changes in CMS reimbursement have placed 30-day readmissions after HF hospitalization into the spotlight, giving incentives to hospitals

\* Corresponding author at: Center for Cardiovascular Innovation, Northwestern University, Feinberg School of Medicine, 201 East Huron, Galter 3-150, Chicago, IL 60601, USA. Tel.: +1 312 695 0051; fax: +1 312 926 7260.

E-mail address: [m-gheorghiade@northwestern.edu](mailto:m-gheorghiade@northwestern.edu) (M. Gheorghiade).

**Table 1**

Initiating mechanisms, underlying cardiac substrate, and amplifying mechanisms in patients hospitalized for heart failure.

Abnormalities	Assessment	Therapy
Initiating mechanisms		
Hypertension	Vital signs	Vasodilators
Ischemia	ECG, troponin	Antiplatelet, reperfusion
Arrhythmias	ECG	Rate and rhythm control, pacemaker implantation
Medication non-compliance	History	Education
Infection	Vital signs, CBC with differential, blood and urine cultures, chest radiograph	Antibiotics
Underlying cardiac substrate		
Systolic dysfunction	Echocardiogram, left and right heart catheterization	ACEI/ARB, beta-blocker, MRA, digoxin, ICD
Coronary artery disease	Stress test, coronary angiogram	Antiplatelet, beta-blockers, revascularization
Valvular heart disease	Echocardiogram with Doppler	Valve surgery or percutaneous valve implantation
Viable dysfunctional myocardium	Cardiac MRI, nuclear rest-redistribution study, dobutamine echocardiogram	ACEI/ARB, beta-blocker, MRA, consider revascularization
Cardiac dyssynchrony	QRS duration on ECG	Cardiac resynchronization therapy
Amplifying mechanisms		
COPD	Pulmonary function tests, oxygen saturation	Bronchodilators, steroids, oxygen, smoking cessation
Diabetes mellitus	Blood glucose, HbA1c	Diet and exercise, oral hypoglycemic, insulin
Renal dysfunction	Blood urea nitrogen, serum creatinine, estimated glomerular filtration rate, urine output	Optimize hemodynamics, ACEI/ARB

Table adapted and modified with permission from Gheorghiade and Peterson [13].

ACEI, angiotensin-converting enzyme inhibitor; ARB, angiotensin II receptor blocker; CBC, complete blood count; COPD, chronic obstructive pulmonary disease; ECG, electrocardiogram; HbA1c, hemoglobin A1c; ICD, implantable cardioverter-defibrillator; MRI, magnetic resonance imaging.

and associated care facilities to become involved in reducing post-discharge event rates.

Despite these broad-ranging targeted efforts, post-discharge outcomes after index HF admissions have remained dismally high. Although recent temporal trends suggest improvements in certain inpatient care measures including in-hospital mortality and length of stay [5], the 30-day readmission [6] and 1-year post-discharge mortality rates [7] have remained unchanged at 25% and 30%, respectively. In contrast to the great strides in chronic HF management in reducing mortality, almost every drug development program conducted in hospitalized HF patients has failed in terms of safety and/or efficacy [8]. Although new therapies have not been added to the inpatient HF armamentarium, a step-wise, evidence-based approach should be taken in the care of patients hospitalized with HF. This review will provide an updated, contemporary roadmap for inpatient HF management. Table 1 provides a guide to identifying the critical initiating mechanisms, amplifying factors, and cardiac structural abnormalities during an HF hospitalization care episode.

### Identifying initiating mechanisms

Although congestion management is critical to improving symptoms and readmission risk in HF, inpatient management

extends beyond diuresis alone. The first step in the evaluation of patients hospitalized for HF involves identifying the initiating mechanism that precipitated the index admission. Based on data from almost 50,000 patients included in OPTIMIZE-HF (Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients with Heart Failure), approximately 60% of patients had one or more clearly identifiable precipitants of HF hospitalization [9] (Fig. 1). Among them, pneumonia, ischemia, and arrhythmia were most common (each representing ~15% of cases) and independently increased the hazard of poor in-hospital outcome [9]. Acute coronary syndromes can present as new or worsening HF, which require prompt interventional and pharmacologic management [10]. However, based on large national registry data from the USA, it is notable that the rates of in-hospital procedures including cardiac catheterization are low during HF admissions [11–13]. Clinicians should inquire about potentially harmful medication use (including non-steroidal anti-inflammatory drugs, certain calcium channel blockers, and nasal decongestants), and comorbid diseases that could trigger worsening HF [systemic infection, anemia, thyroid disease, chronic obstructive sleep apnea, chronic obstructive pulmonary disease (COPD)]. Indeed, data from Premier Perspective<sup>®</sup> (Charlotte, NC, USA) of 164,494 HF hospitalizations showed that over 50% of patients received broad respiratory therapies targeted toward COPD, asthma, and intercurrent infection [14]. The majority of these precipitants can

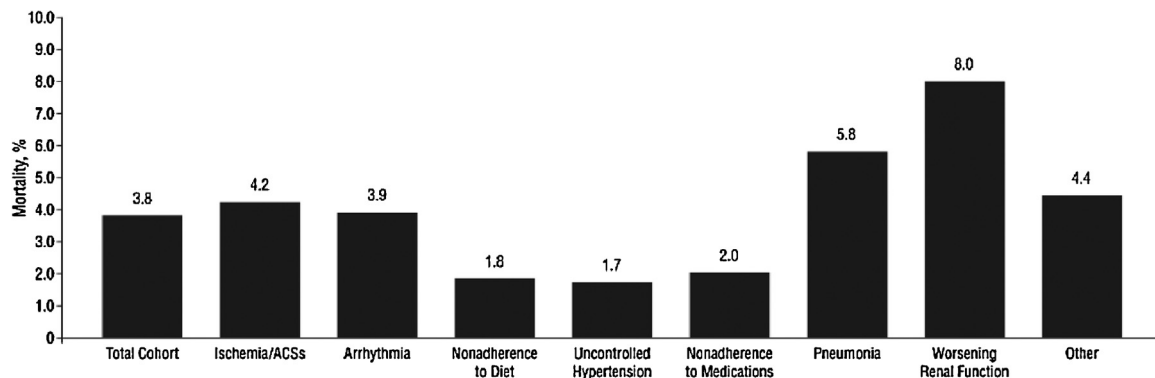


Fig. 1. Unadjusted in-hospital mortality rates by precipitating factors for heart failure admission. ACS, acute coronary syndrome. Figure reproduced with permission [9].

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